

A STUDY OF NORTH AMERICAN *VEIGAIA* (ACARINA : MESOSTIGMATA) WITH COMPARISONS OF HABITATS OF UNISEXUAL AND BISEXUAL FORMS

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TAXONOMY
VEIGAIA
NORTH
AMERICA
BISEXUAL
AND
UNISEXUAL
POPULATIONS

SUMMARY : Five new species of *Veigaia*, *V. preendopodalia*, *V. sylvatica*, *V. philippiensis*, *V. incisa* and *V. nodosoides* are described and a key to North American species is given. *V. mitis* Berlese is redescribed. *V. mitis* has bisexual populations in Maryland and North Carolina, but in West Virginia and in the northern part of its range only females are known. Unisexual forms of *Veigaia* tend to be associated with marginal habitats.

TAXONOMIE
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UNISEXUÉES
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RÉSUMÉ : Cinq espèces nouvelles de *Veigaia* sont décrites, *V. preendopodalia*, *V. sylvatica*, *V. philippiensis*, *V. incisa* et *V. nodosoides*, et une clé pour les espèces Nord Américaines est établie. *V. mitis* Berlese est redécrite. *V. mitis* a des populations bisexuées dans le Maryland et en Caroline du Nord, tandis qu'en Virginie Occidentale et dans la partie nordique de son aire seules les femelles sont connues. Les formes unisexuées de *Veigaia* ont tendance à être associées à des habitats marginaux.

In the forest floors of eastern United States probably no genus of predatory mites is richer in number of species (and often in numbers of individuals) than the genus *Veigaia* (Mesostigmata : Veigaiidae). Thirteen species have been found in one hectare of forest and brush in northern West Virginia. *Veigaia* is also plentiful in fields and old orchards and has been reported in mammal nests.

The family Veigaiidae was extensively reviewed by FARRIER (1957) who provided descriptions, illustrations and bibliographies of species known

at the time including thirteen species from North America. The monograph of Veigaiidae from USSR (BREGETOVA, 1961) includes illustrations of several species occurring in North America. Other papers on North American *Veigaia* are those of HURLBUTT (1965) and PIKE and JARROLL (1977).

Three genera, of which *Veigaia* is by far the largest, particularly in North America, comprise the family Veigaiidae. *Cyrtodrolaelaps* includes six known species, only one of which has been found in North America (under beach debris in Florida). *Gamasolaelaps* (= *Gorirossia* Farrier),

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recently reviewed by HURLBUTT (1982), contains eleven species of which only one, *G. whartoni* (Farrier) occurs in North America. *G. whartoni* has been found in North Carolina (type locality), Louisiana, Florida (Everglades Park) and Romney, West Virginia. The latter record is its only known occurrence in northeastern United States. *G. whartoni* also occurs in Africa, Japan and southern USSR. Including species described in the present paper *Veigaia* contains fifty described species of which twenty-five occur in North America. The occurrence of several common undescribed species in Appalachia and the discovery of unisexual and bisexual races of *V. mitis* prompted the present study.

The setal nomenclature used in this study is that of LINDQUIST and EVANS (1965). ADS and PDS are used as abbreviations for the anterior dorsal shield and posterior dorsal shield. The term inguinal gland replaces the punctiform organ of earlier authors. Holotypes have been deposited in the collection at the United States National Museum.

Key to females of *Veigaia* occurring in North America

1. With two completely separate dorsal shields... 2
 - Dorsum only partially divided by transverse incisions leaving anterior and posterior dorsal shields joined medially 4
2. Fixed digit of chelicera with 15 to 21 small, low teeth between two larger teeth (Fig. 6); genital shield rounded laterally, not connected to ventral shield..... *planicola* (Berlese)
 - Fixed digit of chelicera with two to four normal teeth; genital shield connected laterally to ventral shield 3
3. Palp genu with anteromedial seta combed (Fig. 2); peritremal shield not joined to ventral shield..... *nemorensis* (Koch)
 - Palp genu with anteromedial seta not combed; peritremal shield joined to ventral shield; found in Canada and adjacent U.S. *kochi* (Trägårdh)
4. With conspicuous hook on femur IV (Fig. 11); anal shield with three setae..... *uncata* Farrier
 - Femur IV without hook; anal shield usually with five setae (three in *V. cerva*)..... 5
5. Ventral shield with nearly parallel sides, four pairs of setae (Fig. 8); small pale mites with median tine of tectum brushlike..... 6
 - Ventral shield trapezoidal, narrowing posteriorly, with five or six pairs of setae; median tine of tectum usually Y-shaped..... 7

6. With long internal tubules; ventral shield 60-63 μ m long at midline..... *agilis* (Berlese)
 - With internal sacs (spermathecae); ventral shield 43-46 μ m at midline..... *pusilla* (Berlese)
7. Lateral incisions of dorsal shield deeply oblique; digits of chelicerae long and crossing distally (Fig. 10); anal shield with three setae; median tine of tectum brushlike..... *cerva* (Kramer)
 - Lateral incisions of dorsal shield transverse except at apex; digits of chelicerae not crossing; anal shield with five setae; median tine of tectum Y-shaped 8
8. Palp genu with anteromedial seta simple, without teeth (Fig. 16). 9
 - Palp genu with anteromedial seta combed or forked 13
9. Posterior dorsal shield with less than 15 pairs of setae; with T-shaped sclerotization near junction of dorsal shields..... *V. partitus* (Banks)
 - Posterior dorsal shield with over 18 pairs of setae; without T-shaped sclerotization..... 10
10. With peritremal shield joined laterally to ventral shield (Fig. 32)..... 11
 - Peritremal shield not joined to ventral shield (Fig. 34)..... 12
11. Poststigmatal seta over 30 μ m behind center of stigma; with two pairs of preendopodals (but the posterior pair is indistinct in some localities)..... *V. preendopodalia* n. sp.
 - Poststigmatal seta under 20 μ m behind center of stigma; with one pair of preendopodal shields..... *V. mitis* (Berlese)
12. Trochanter IV with conspicuous, stout spine on posterior margin (Fig. 26); posterolateral seta of ventral shield not on edge of shield (Fig. 23)..... *V. sylvatica* n. sp.
 - Setae on trochanter IV not conspicuously thickened (Fig. 34); posterolateral seta of ventral shield on edge of shield..... *V. philippiensis* n. sp.
13. Some dorsal setae (i.e. r3, j4 and z5) conspicuously longer than other dorsal setae, z5 over 1 1/2 \times length of j5..... 14
 - Dorsal setae approximately uniform in length.. 19
14. Posterior margin of posterior dorsal shield with conspicuous indentation; idiosoma about 1 000 μ m long *V. gigantea* Pike and Jarroll
 - Posterior margin of posterior dorsal shield straight or slightly concave, but not with V-shaped indentation; idiosoma under 800 μ m long..... 15

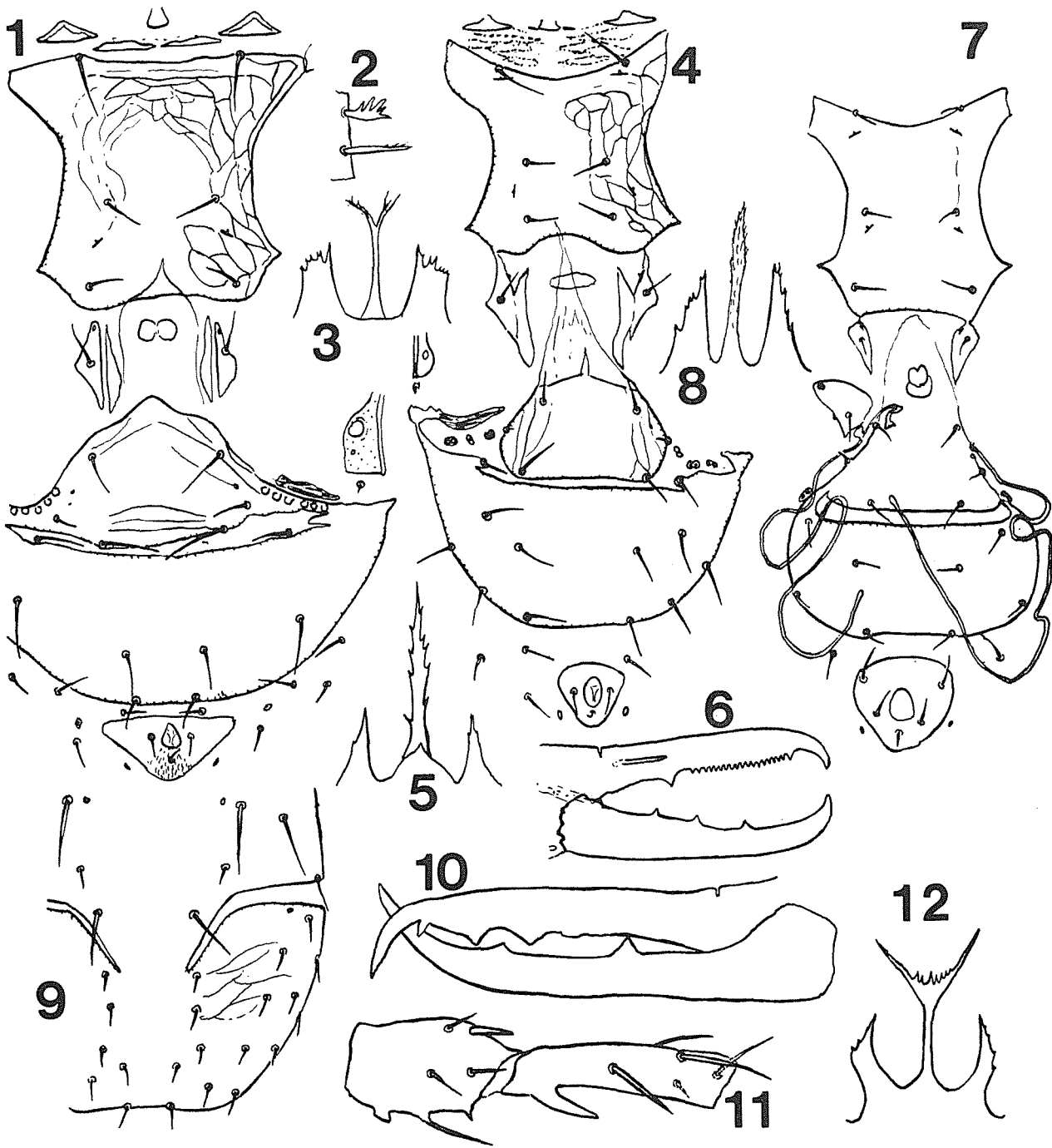


FIG. 1-12 : *Veigaia* spp.

1. — *V. nemorensis* ♀, venter. 2. — *Idem*, palp genu. 3. — *Id.*, tectum. 4. — *V. planicola* ♀, venter. 5. — *Idem*, tectum.
 6. — *Id.*, chelicera. 7. — *V. agilis* ♀, venter. 8. — *Idem*, tectum. 9. — *V. cerva* ♀, posterior dorsal shield. 10. — *Idem*,
 chelicera. 11. — *V. uncata* ♀, trochanter and femur IV. 12. — *Idem*, tectum.

15. Chelicerae very long, moveable digit of chelicera distinctly longer than sternal shield; fixed chela with tooth on basal half..... 16
- Chelicerae shorter, moveable digit of chelicera less than sternal shield; fixed chela without basal tooth..... 17
16. Seta behind j1 (= cervical seta) less than 1/2 length of latter; moveable digit of chelicera 220-234 μm , with small basal tooth.....
V. bakeri Farrier
- Seta behind cervical seta over 2/3 length of latter; moveable digit of chelicera under 220 μm , without basal tooth..... *V. locha* Hurlbutt
17. Preanal setae of anal shield and posterolateral setae of ventral shield flame-shaped (Fig. 59); seta r3 and posteromedial setae of ventral shield pilose; ventral peritremal shields joined laterally by narrow isthmus..... *V. ignaseta* Farrier
- Setae on anal, ventral and dorsal shields not flame-shaped or pilose; ventral and peritremal shields not joined laterally..... 18
18. Sternal shield with unsclerotized area posteromedially (Fig. 41); moveable digit of chelicera 70-77 μm *V. incisa* n. sp.
- Sternal shield normal, posterior border as heavily sclerotized as rest of shield; moveable chela 80-89 μm *V. hurlbutti* Pike and Jarroll
19. Anal shield with pilose preanal setae, dorsal setae also pilose..... *V. piliseta* Farrier
- Setae on anal shield not pilose..... 20
20. First sternal setae and pores not on sternal shield..
V. alba Hurlbutt
- First sternal setae and pores on sternal shield.. 21
21. Idiosoma over 800 μm ; edge of genital shield around postgenital setae slightly lobed (Fig. 51). 22
- Idiosoma under 700 μm ; edge of genital shield around postgenital setae not lobed..... 23
22. Inguinal gland with 23 solenostomes; lateral lobes of tectum serrate..... *V. nodosoides* n. sp.
- Inguinal gland with 14-18 solenostomes; lateral lobes of tectum not serrate.. *V. nodosa* Hurlbutt
23. Preanal setae short and flame-shaped, posterolateral setae of ventral shield slightly thickened also....
V. virginiana Pike and Jarroll
- Setae on anal and ventral shields not thickened.... 24
24. Fixed digit of chelicera with proximal tooth; seta r3 pilose..... *V. smithi* Farrier
- Fixed digit of chelicera only with distal teeth; seta r3 not pilose..... *V. dendritica* Hurlbutt

Veigaia preendopodalia n. sp.
(Figs. 13-21)

Holotype female. Idiosoma 490 μm , lateral incisions transverse. Anterior dorsal shield with 20 pairs of setae, j3, j4, z5 and r3 longer than other setae. Seta j2 15, j3 40, j4 45, z5 50, r3 70 μm .

Two pairs of preendopodal shields present, anterior pair triangular, posterior pair oval. Sternal shield with conspicuous ornamentation except for posteromedial part. Distance between postgenital setae 62 μm . Inguinal gland with six solenostomes, mostly in one row. Peritremal shield joined to anterolateral corner of ventral shield, with seta behind posteromedial corner of stigma. Distance from center of stigma to poststigmatal seta 32 μm , with small dark stippled area behind poststigmatal seta. Ventral shield widest behind stigma, with six pairs of setae, posterolateral seta 11 μm . Preanal setae simple, not thickened. Setae on membrane between ventral and posterior dorsal shields strap shaped.

Tectum as in Fig. 15. Chelicerae as in *V. sylvatica*. Anteromedial seta on palp genu simple, posteromedial seta with six prongs directed anteriorly, seta on palp femur simple. Tarsus I 128, tarsus IV 175 μm long. Ventral seta on trochanter IV arising from slight mound, only slightly thicker than adjacent setae.

Measurements. ADS 280, PDS 210, sternal shield 105-110, ventral shield 97 μm . Seta z5 50-54, r3 70-82 μm , moveable digit of chelicera 63-66 μm .

Male. Idiosoma 510 μm long, dorsal setae similar to female, j3 45, r3 66 μm . With one pair of preendopodal shields lateral to tritosternum, another flanking genital opening. Sternogenital shield 180 μm long, st2-st2 68 μm . Inguinal gland with six solenostomes arranged in a single line on edge of shield. Dorsal shield fused to both peritremal and ventroanal shields, but with membranous indentation between stigma and poststigmatal seta.

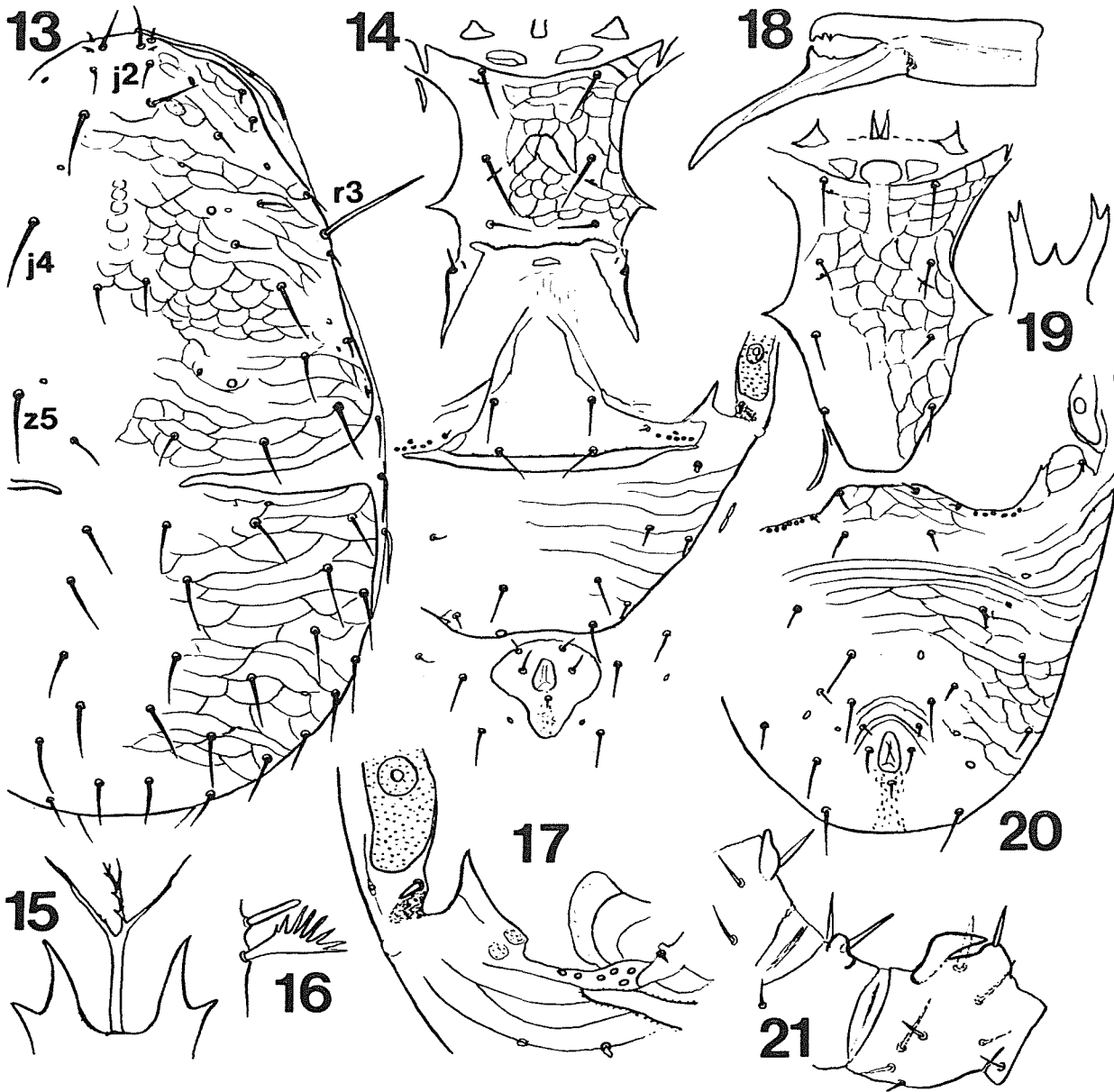


FIG. 13-21 : *Veigaia preendopodalia* n. sp.

13. — ♀, dorsal shields. 14. — *Idem*, venter. 15. — *Idem*, tectum. 16. — *Idem*, palp genu. 17. — *Idem*, area behind stigma. 18. — ♂, chelicera. 19. — *Idem*, tectum. 20. — *Idem*, venter. 21. — *Idem*, femur, genu and tibia II.

Tectum with short medial tine, longer bifid lateral ones. Spermadactyl extending 80 μ m past tip of moveable digit, slightly curved backwards.

Type locality. Maple, hemlock leaf litter near trail to Cranesville Swamp, Cranesville, West Virginia, 29 May 1979.

Distribution. Three ♀♀, ♂ from type locality. *V. preendopodalia* has also been collected from deciduous litter in the following localities : Muskegon, Michigan (behind sand dune) ; Mt. Everett, Massachusetts ; Beach Pond, Rhode Island ; Swallow Falls, Maryland ; Mt. Storm, West Virginia ; Round Mountain, Greenbrier Co., West Vir-

ginia (850 m., under chestnut oak) ; Potts Mountain, Craig Co., Virginia ; Comers Rock, Virginia ; Naples, North Carolina. The second pair of preendopodals is indistinct in the four latter localities. Males were found in West Virginia and North Carolina, but not in New England or Michigan. In the southern part of its range *V. preendopodalia* has been found only in mountainous areas.

Remarks. The presence of two pairs of preendopodal shields makes adults from the northern part of the range easy to recognize. In some individuals the second pair of preendopodals is indistinct. These individuals are hard to distinguish from *V. mitis*, but the area adjacent to coxa IV is different (Fig. 17). The poststigmatal seta is 32-35 μm behind the center of the stigma in *V. preendopodalia*, only 18 μm in *V. mitis* and the inguinal gland of *V. mitis* has solenostomes arranged compactly in two rows, whereas *V. preendopodalia* has six arranged mostly in one row. In addition, the dorsal setae are somewhat longer in *V. preendopodalia*, $z5 = 50\text{--}54\ \mu\text{m}$ and $r3\ 73\text{--}82\ \mu\text{m}$ versus $36\text{--}48\ \mu\text{m}$ and $52\text{--}71\ \mu\text{m}$ for *V. mitis*. (In the unisexual race of *V. mitis* $r3$ is not over 64 μm).

***Veigaia sylvatica* n. sp.**

(Figs. 22-31)

Holotype female. Idiosoma 520 μm , lateral incisions transverse. Anterior dorsal shield with 20 pairs of setae. Setae $j1$, $j3$, $j4$, $z5$ and $r3$ longer than other setae, $j1\ 43$, $j2\ 24$, $j3$, $j4$ and $z5\ 33\ \mu\text{m}$, $r3\ 59\ \mu\text{m}$. PDS with 20 pairs of uniform (25 μm) setae.

Sternal shield with polygonal ornamentation. Anterolateral part of metasternals fused to sternal shield. With conspicuous paired, heavily sclerotized internal organ medial to coxa IV, shaped like a 6 or a coiled cercaria. Genital shield with conspicuous bell-shaped groove. Inguinal gland with 17 solenostomes. Peritremal shield bearing a small, thickened seta on broad lobe behind stigma, not joined to ventral shield. Membrane

between stigma and incision in dorsal shield with two adjacent setae ; these and poststigmatal seta form a transverse row. Ventral shield with six pairs of setae, $V2$ and $V3\ 26\ \mu\text{m}$, posterolateral seta 15 μm long, about 5 μm from edge of shield. Preanal setae simple, not thickened. Setae on membrane between ventral and posterior dorsal shields simple.

Tectum as in Fig. 25. Anteromedial seta on palp genu simple (finely serrate distally), posteromedial seta with six prongs directed anteriorly, seta on palp femur serrate distally. Palp tarsus with stiff, pointed solenidion 34 μm long. Tarsus I 135, tarsus IV 165 μm . Trochanter IV with conspicuous stout spinelike seta (30 μm) on posterior margin, no dorsal hump.

Measurements. Idiosoma 520, ADS 300-320, PDS 200-220, sternal shield 125-132, ventral shield 101-113 μm . Seta $j3\ 31\text{--}34$, $z5\ 33$, $r3\ 55\text{--}59\ \mu\text{m}$, moveable digit of chelicera 65-67 μm .

Male. Idiosoma 540, $j1\ 52$, $r3\ 61\ \mu\text{m}$. Dorsal chaetotaxy as in female. Venter as in fig. 29. Sternotogenital shield 200 μm long, $st_2\text{--}st_2\ 60\ \mu\text{m}$, inguinal gland with 17 solenostomes arranged in two rows behind coxa IV. Tectum carinate, with five points (Fig. 31). Spermadactyl long, slender, recurved, approximately length of moveable digit of chelicera. Knob on femur II with pointed posterior end (Fig. 27). Setae on trochanter IV normal, ventral setae on genu and tibia III and IV stiff, spinelike and slightly thickened, longest seta on tibia IV 78 μm .

Deutonymph. Idiosoma 370 μm , dorsal setae as in female, $z5\ 26$ $r3\ 42\ \mu\text{m}$ long. Distance $j5\text{--}j5\ 33\ \mu\text{m}$, greater than length of $j4$. PDS 110 μm long, only slightly concave. Sternal shield 155 μm long, with polygonal ornamentation. Post sternal platelets separate of fused. Inguinal gland on distinct plate, with 17 pits. Post stigmatal seta on membrane. Medial setae of opisthogaster about $1\ 1/2 \times$ length of more lateral setae, i.e. $jv3 = 21$, $Zv3 = 14\ \mu\text{m}$. Tectum and palps as in female. Moveable digit of chelicera 53 μm . Deutonymphs were found only in the summer months.

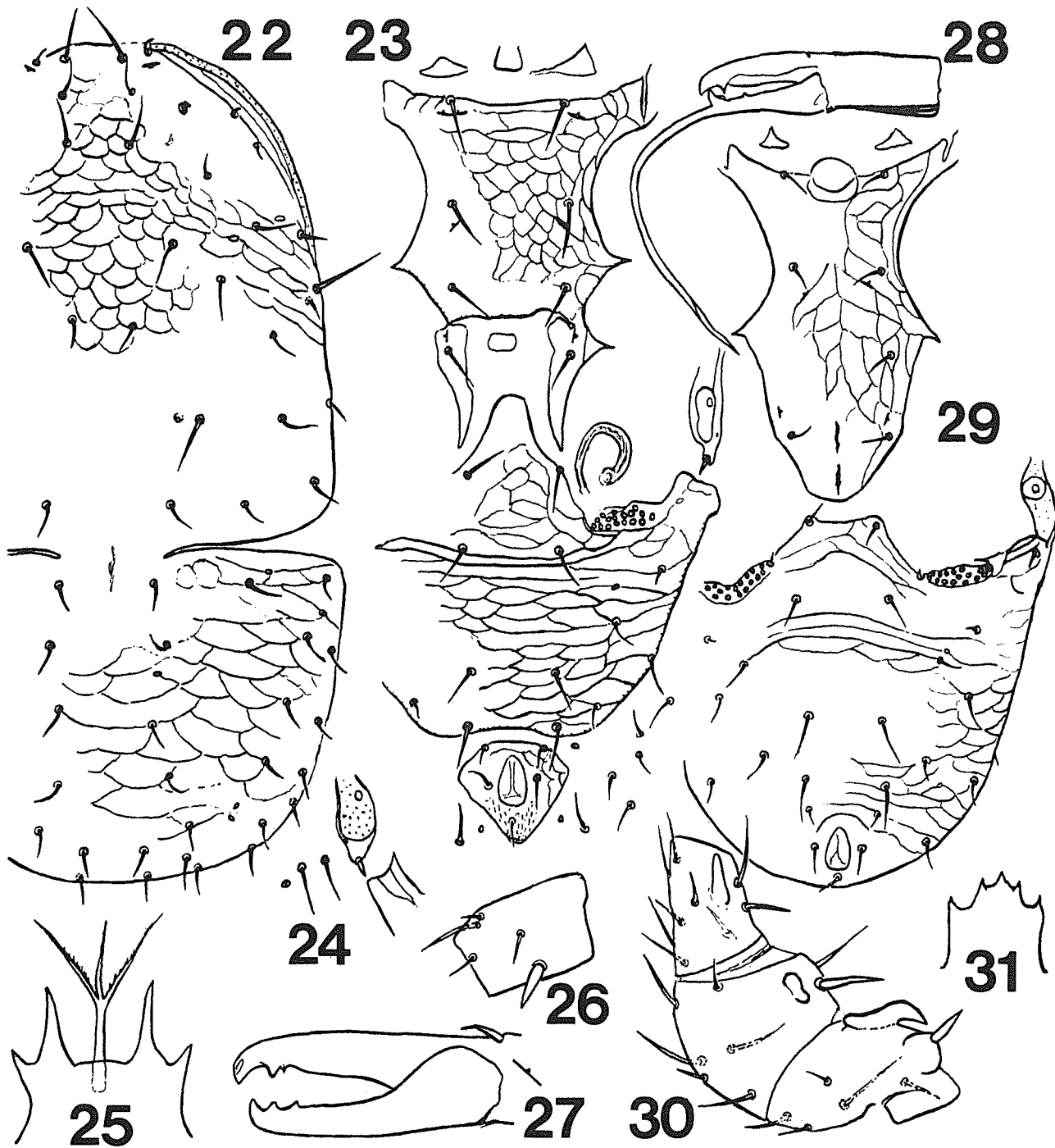


FIG. 22-31 : *Veigaia sylvatica* n. sp.

22. — ♀, dorsal shields. 23. — *Idem*, venter. 24. — *Idem*, area behind stigma. 25. — *Idem*, tectum. 26. — *Idem*, trochanter IV. 27. — *Idem*, chelicera. 28. — ♂, chelicera. 29. — *Idem*, venter. 30. — *Idem*, femur, genu and tibia II. 31. — *Idem*, tectum.

Type locality. Leaf litter under tulip tree, mixed deciduous, forest, Tibbs Run Reservoir, Morgantown, West Virginia, 19 June 1979.

Distribution. *Veigaia sylvatica* is abundant at the type locality. It has also been collected in forest litter from the following localities in West Virginia : Coopers Rock State Forest, Monongalia County ; Bruceton Mills, Terra Alta, Cranesville, Preston County ; Harman, Randolph County ; and Mt. Storm, Grant County. *V. sylvatica* occurs almost exclusively within forests where it lives in both the H and L & F layers of the forest floor. I have found only three individuals in marginal habitats versus two hundred in forests.

Seasonal distribution is as follows (DN = deutonymph) : May, 9 ♀♀, 1 DN ; June, 3 ♀♀, 20 DN (two transforming into female) ; August, 14 DN, no adults ; October, 34 ♀♀, 16 ♂♂, November 26 ♀♀, 19 ♂♂ ; January 3 ♀♀, 3 ♂♂ ; February, 19 ♀♀, 17 ♂♂. Although several samples from the type locality were collected in July, no *V. sylvatica* were recovered then. Thus deutonymphs appear to be absent in autumn and winter while adults were not found in the summer. Males and females were approximately equally numerous.

Distinguishing characters. Female with stout spine on trochanter IV, internal organ shaped like a 6, tectum of male convex in outline. In both sexes and in the deutonymphs anterior seta on palp genu simple, inguinal gland behind coxa IV with 17 solenostomes.

***Veigaia philippiensis* n. sp.**
(Figs. 34-39)

Holotype female. Idiosoma 530 μ m, lateral incisions transverse, not curving backward. Positions and relative lengths of dorsal setae as in *V. sylvatica*, j1 38, j3 and z5 32, r3 55 μ m long. Posterior dorsal shield with 20 pairs of uniform (25 μ m) setae.

Sternal shield with polygonal ornamentation,

slightly convex posteromedially. Anterolateral part of metasternals fused to sternal shield. Inguinal gland with twelve solenostomes. Peritremal shield bearing a small, thickened seta on narrow lobe behind stigma, not joined to ventral shield. Membrane between stigma and incision in dorsal shield with two adjacent setae. Ventral shield with six pairs of setae, posterolateral seta on edge of shield. Preanal setae simple, not thickened.

Tectum, chelicerae as figured. Trochanter IV with small dorsal hump, seta on posterior margin, not noticeably stouter than other setae.

Measurements. Idiosoma 480-530 μ m, sternal shield 114-122, ventral shield 105-120 μ m long. Seta j1 37-38, j3 31-33, z5 31-34, r3 50-56 μ m, moveable digit of chelicera 65-69 μ m, tarsus I 125, tarsus IV 155 μ m long.

Male. Idiosoma 400 μ m long, dorsal setae similar to female, j1 30, r3 48 μ m, slightly pilose, ventral sclerotization as in *V. sylvatica*. Sternogenital shield 200 μ m long, st₂-st₂ 65 μ m. Inguinal gland with twelve solenostomes arranged in two rows plus minute seta behind coxa IV. Lateral lobes of tectum longer than medial point. Spermadactyl extending only slightly past tip of moveable chela. Apophysis on femur II hook-like, pointing posteriorly toward rounded, seta-bearing knob. Ventral setae on genu and tibia III and IV stiff, spinelike and slightly thickened.

Deutonymph. Anterior dorsal shield 245 μ m long, with setae j1, j3, j4, z5 and r3 somewhat longer than other setae, j1 32, z5 28, r3 38 μ m long. Distance j5-j5 37 μ m. Posterior dorsal shield 110 μ m long, only shallowly indented, with 11 pairs of setae. Sternal shield 160 μ m long, post sternal platelets coalesced. Inguinal gland with 13 solenostomes. Poststigmal seta on membrane, with another seta just lateral to it. Medial setae of opisthogaster (Jv1, Jv2 and Jv3) about 1 1/2 \times length of more lateral setae, i.e. Jv3 = — 1, Zv3 = 14 μ m.

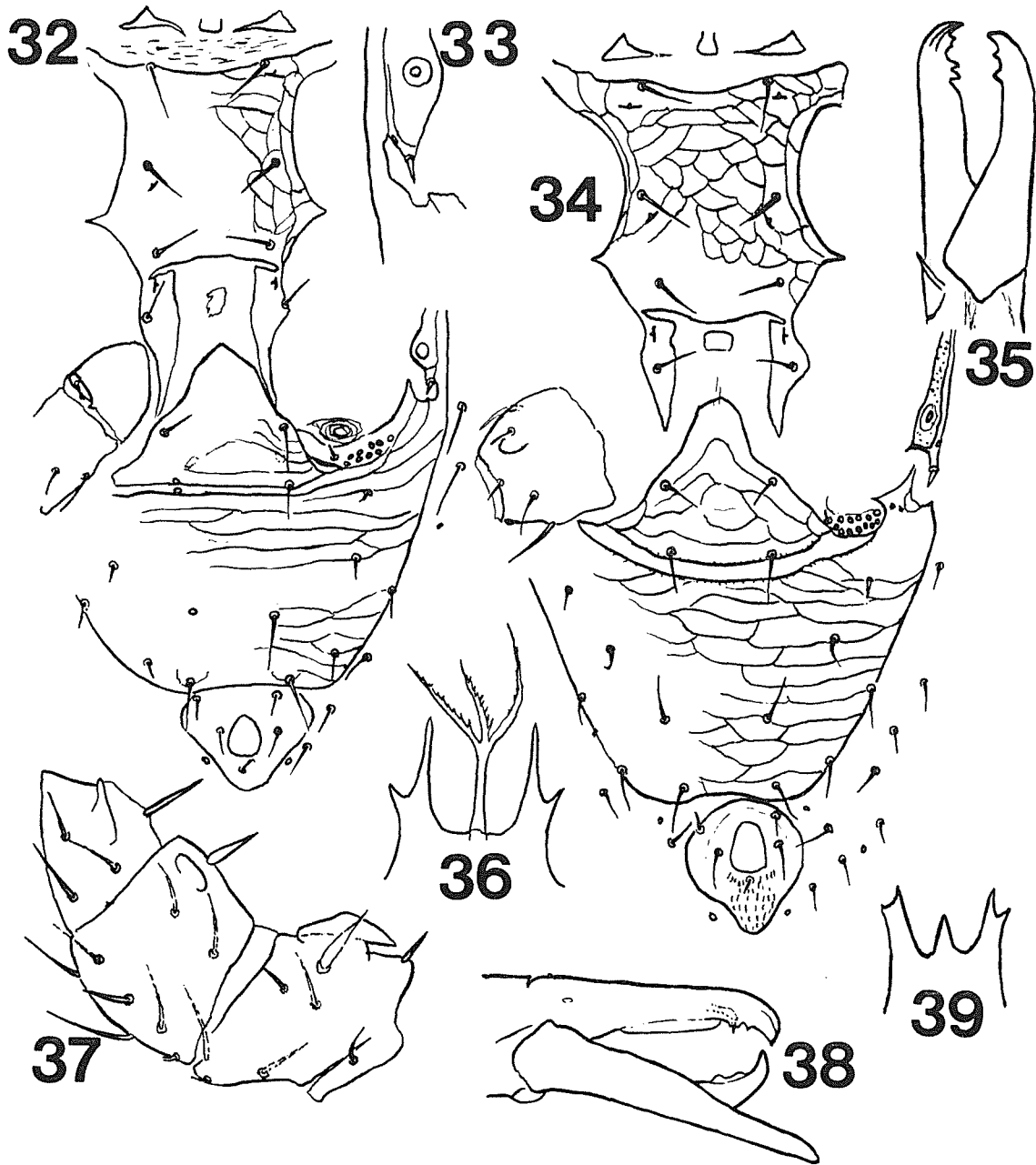


FIG. 32-39 : *Veigaia* spp.

32. — *V. mitis* ♀, venter. 33. — *Idem*, area behind stigma. 34. — *V. philippiensis* n. sp., ♀, venter. 35. — *Idem*, *Ibid.*, chelicera. 36. — *Idem*, *Ibid.*, tectum. 37. — *Idem*, ♂, leg II. 38. — *Idem*, ♂, chelicera. 39. — *Idem*, ♂, tectum.

Type locality. Thin leaf litter on rocky hillside, Route 250, southeast of Phillipi, West Virginia, 10 November 1973.

Distribution. Seven ♀♀, eight ♂♂ ex type locality; 95 ♀♀, 94 ♂♂ from oak-maple litter, Chestnut Ridge, West Virginia. Only adults of *V. philippiensis* were present from November until early June. Only deutonymphs were found from late June until October which suggests that this species of mite has a life cycle of one year.

Veigaia mitis (Berlese), 1916
(Figs. 32-33)

Females. Anterior dorsal shield with 21 pairs of setae of which j1, j3, j4, z5 and r3 are longer than other dorsal setae. Seta j5 only 15 µm long, j5-j5 20 µm. Incision between dorsal shields transverse, straight, not curving posteriorly. Ornamentation of sternal shield polygonal. Genital shield with bell-shaped groove. Inguinal gland with 6-8 solenostomes. Lateral portion of peritremal shield narrowly fused to ventral shield, poststigmatal seta 18 µm behind center of stigma (Fig. 32). Posterolateral seta of ventral shield (Zv3) about 10 µm from edge of shield.

Lateral lobes of tectum bifid, not serrate, median tine three-branched. Anteromedial seta on palp genu simple, posteromedial seta with six prongs. Tarsus I 125, tarsus IV 150 µm. Trochanter IV without humps, setae on trochanter normal, not especially thickened. Seta on tibia IV slightly pilose.

Measurements (females of unisexual race). Idiosoma 445-480 µm, sternal shield 97-107, ventral shield 85 µm. Seta j1 37-42, j2 26-31, j3 32-36, z5 37-43, r3 52-64 µm, moveable digit of chelicera 56-65 µm long.

Males (bisexual race). Idiosoma 500, j1 45, z5 44, r3 70 µm. Sternogenital shield 205 µm long, st₂-st₂ 67 µm, inguinal gland with eight solenostomes. Spermadactyl swordlike, extending 60 µm past tip of chelicera. Tectum, leg II as figured.

Deutonymphs (unisexual race). Anterior dorsal shield 230-250 µm long, with j1, j3, j4, z5 and r3 longer than other dorsal setae, z5 32-34 µm, r3 41-45 µm. Distance j5-j5 18-20 µm. Posterior dorsal shield 107-115 µm, only shallowly indented, with 11 pairs of setae. Sternal shield 135-150 µm long, poststernal platelets separate. Inguinal gland with eight solenostomes. Poststigmatal seta on lobe behind stigma. Medial setae of opisthogaster (Jv1, Jv2 and Jv3) much longer than more lateral setae, i.e. Jv3 = 19-22 µm, Zv3 = 9 µm. Jv3 arising from protuberances. Moveable digit of chelicera 44-48 µm long.

Type specimen. The type female of *V. mitis* was collected from rotting leaves, Columbia, N.A. (probably Columbia, Missouri) and is in the BERLESE collection at Florence, Italy. It is in poor condition, but according to Dr. DON JOHNSTON the palp genual setae resemble the drawing of FARRIER (1957) of *V. mitis* and the body length is 508 µm. In the original description BERLESE noted that the ventral scutum is well extended laterally beyond coxa IV and borders on the stigma. This still leaves open the question of which member of the *V. mitis* complex BERLESE described since most of his description could apply to several species of *Veigaia*. BERLESE noted several weak tubercles on trochanter IV but did not mention a stout spine such as occurs in *V. sylvatica*. The broad geographic distribution of the mite described by FARRIER as *V. mitis* makes it a likely candidate; *V. sylvatica* and *philippiensis* are known only from Appalachia.

Distribution. *V. mitis* appears to include both bisexual populations (presently known only from Maryland and North Carolina) and more widely distributed unisexual populations. These differ slightly in certain measurements, but I have mainly used simple presence or absence of males in designating material as bisexual or unisexual.

Bisexual race. Maryland: Patuxent Wildlife Refuge, Bowie, 84 ♀♀, 78 ♂♂, 41 DN, also Brown's Bridge (Howard Co.), Laurel, Spencerville; North Carolina: Umstead State Park, near

Raleigh, 39 ♀♀, 16 ♂♂, 42 DN (North Carolina data from METZ and FARRIER, 1969).

Unisexual race. Quebec : *Tsuga canadensis* mor, Arboretum near Montreal ; New Hampshire : Cannon Mt. (from FARRIER) ; Massachusetts : Mt. Everett ; Rhode Island : ex forest litter, Beach Pond, 10 ♀♀ ; Connecticut : Winsted, Storrs, Gales Ferry, North Stonington, Stonington ; Michigan : behind sand dunes, Muskegon ; Ohio : Vinton, Franklin, Knox and Hocking Co. ; Pennsylvania : sod under *Crataegus*, Greene Co., 17 ♀♀ ; Centre Co. ; West Virginia : Morgantown, 220 ♀♀, several DN, Coopers Rock State Forest, 201 ♀♀, 30 DN, Terra Alta, 48 ♀♀, Phillipi, 4 ♀♀, Monroe Co., 21 ♀♀ ; Virginia : Giles Co., 18 ♀♀ ; Maryland : Ashton, 15 ♀♀, Burtonsville, 15 ♀♀, Severn Park, 16 ♀♀.

In Maryland males, females and deutonymphs were collected throughout the year. Gravid females were found from March to October. Females collected in November through February did not contain visible eggs.

Females of the bisexual race of *V. mitis* from Maryland are slightly larger and have slightly longer setae than females from nearby unisexual populations, but there is some overlap. In addition *V. mitis* shows some seasonal variation in size with females collected in March being somewhat larger than those collected at other times of the year. The unisexual form of *V. mitis* is common in marginal habitats, but also occurs within forests.

A relationship among *V. mitis*, *preendopodalia*, *sylvatica* and *philippiensis* is indicated by such shared features as a bell-shaped groove on the female genital shield, the simple anterior seta on the palp genu, transverse dorsal incisions and a distinctive hook or point on the posterior end of the knob on femur II of males.

***Veigaia incisa* n. sp.**
(Figs. 40-47)

Holotype female. Idiosoma 490 μ m. Anterior dorsal shield with 21 pairs of simple setae. Setae

j1, j3, j4, z5 and r3 longer than other setae, j5 short and close together. Presternal area semi-sclerotized, homogeneous tan, darker than membrane but lighter than sternal shield. Central region of sternal shield unornamented, posterior margin with median incision. Metasternal shields separate. Poststigmal seta near posteromedial corner of stigma. Inguinal gland with ten solenostomes. Genital and ventral shields broad. Setae on ventral shield simple, medial setae longer. Membrane between ventral and posterior dorsal shields with ten pairs of relatively short, simple setae which are neither pilose nor strap-shaped.

Lateral lobes of tectum not toothed. Chelicerae in Fig. 43. Anteromedial seta on palp genu with three prongs, posteromedial seta with six prongs. Trochanter and femur IV without knobs, spurs or thickened setae. Tibial seta slightly pilose.

Measurements of females. ADS 290-320, PDS 195-210, sternal shield 102-125, ventral shield 90-95 μ m. Seta r3 89-95, z5 57-63, moveable digit of chelicera 71-75 μ m, longest seta on tibia IV 120-128, tarsus IV 215 μ m long.

Male. Idiosoma 410-415, sternogenital shield 165-180 μ m. Setae as in female. Area between preendopodal and sternal shields of different texture than most membranous areas. Dorsal, peritremal and ventrianal shields completely fused into one shield. Tectum bilobed, lobes toothed. Moveable digit of chelicera 56-65 μ m long, spermatheca very short, extending only 6 μ m past tip of chela. Knob on femur II not concave.

Type locality. The type specimen was collected from leaf litter from an oak-maple-tulip forest east of Tibbs Run Reservoir, Morgantown, West Virginia on 19 June 1979.

Distribution. *V. incisa* has been collected principally from the type locality, both within the forest and under brush on a dike. It has also been found under hemlock, near Bruceton Mills, West Virginia.

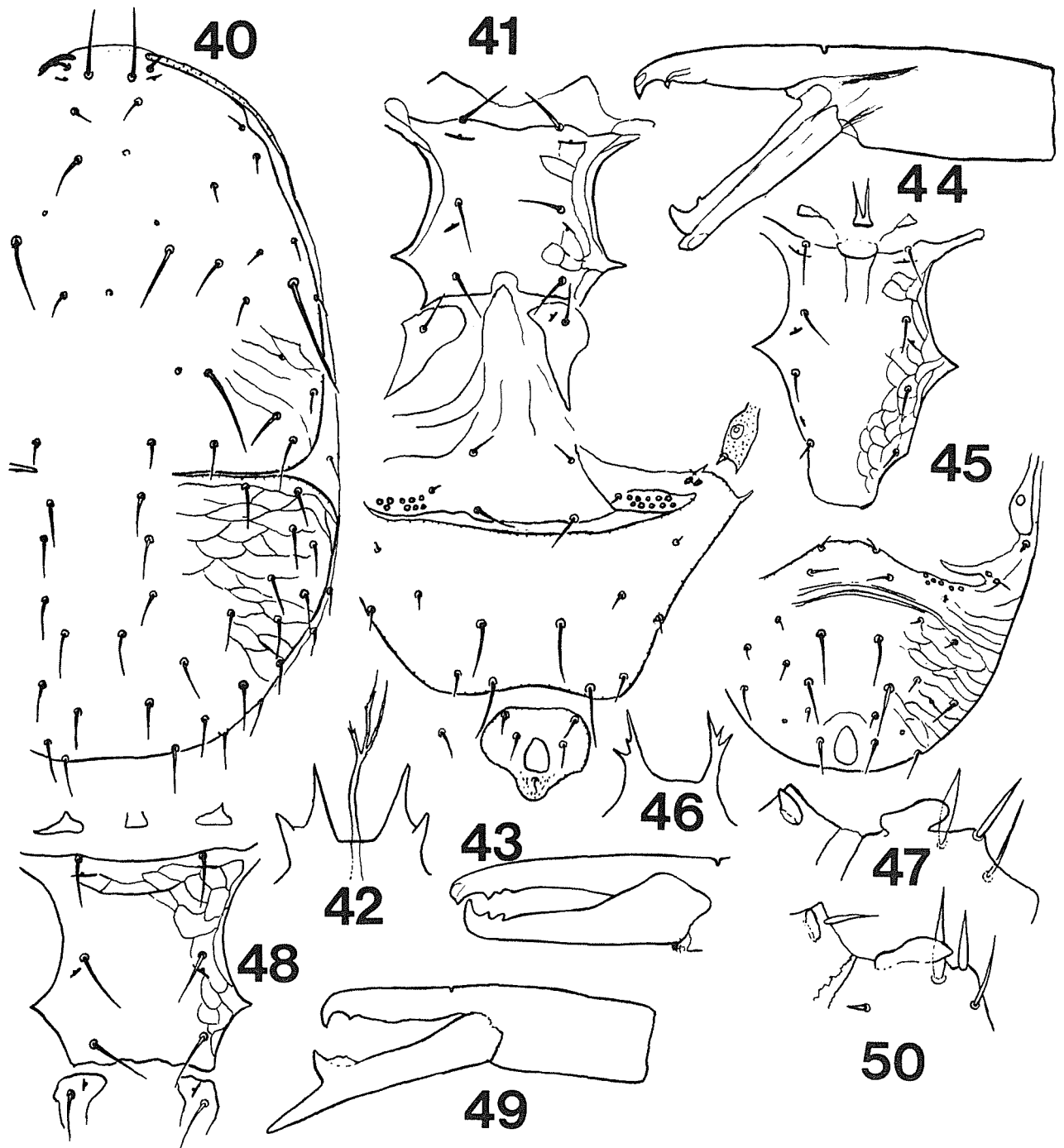


FIG. 40-50 : *Veigaia* spp.

40. — *V. incisa* n. sp., ♀, dorsal shields. 41. — *Idem, Ibid.*, venter. 42. — *Idem, Ibid.*, tectum. 43. — *Idem, Ibid.*, chelicera. 44. — *Idem, ♂*, chelicera. 45. — *Idem, ♂*, venter. 46. — *Idem, ♂*, tectum. 47. — *Idem, ♂*, femur and genu II. 48. — *V. hurlbutti*, ♀, sternal shield. 49. — *Idem, ♂*, chelicera. 50. — *Idem, Ibid.*, femur and genu II.

Remarks. *V. incisa* is very similar to *V. hurlbutti*. Characteristics shared by both mites are as follows : some dorsal setae much longer than others, setae V2 and V3 much longer than adjacent setae, chelicerae relatively short, inguinal gland with ten solenostomes, spermadactyl short and uncurved, tectum of male without medial tine. It may be recognized by the semisclerotized presternal area, the notch on the posterior margin of the female sternal shield (sometimes absent) and the extremely short spermadactyl which barely extends past the tip of the chelicera. Also the moveable digit of the female chelicera is shorter in *V. incisa* than in *V. hurlbutti* (71-75 versus 80-87 μm).

***Veigaia nodosoides* n. sp.**
(Figs 51-57)

Holotype female. Idiosoma 900 μm . Dorsal setae slightly pilose, relatively uniform in length, j1, j2 90, j3 85, j5 58, z5 80, r3 110 μm long. Seta r4 on membrane. Sternal shield slightly concave anteriorly. Metasternal shields separate from sternal shield. Genital shield lobed behind postgenital setae. Inguinal gland with 23 solenostomes, adjacent to conspicuous thickening. Ventral shield not fused to genital shield. Posterolateral seta of ventral shield slightly thickened, other setae simple. Preanal setae somewhat thicker and stouter than other setae. Setae on membrane behind anus short and pilose. Lateral lobes of tectum toothed. Penultimate segment of chelicera 435 μm , fixed digit with basal tooth, two subapical teeth, no blade. Moveable digit with two small teeth 15 and 28 μm from tip of digit. Anteromedial seta of palp genu with four prongs, posteromedial seta with nine prongs directed perpendicular to axis of seta. Long seta on tarsus IV pilose distally.

Measurements. ADS 540-590, sternal shield 185-200, ventral shield 150-165 μm long. Seta r3 105-112, moveable digit of chelicera 202-205 μm long. Tarsus I 250, tarsus IV 345, longest seta on tibia IV 175 μm .

Male. Idiosoma 900 μm long. Sternal shield 360 μm , st₂-st₂ 125 μm . Ventrianal shield fused to dorsal shield posteriorly (Fig. 54). Inguinal gland with 27 solenostomes. Preanal setae somewhat spinelike.

Tectum trilobed, median tine shorter (Fig. 55). Spermadactyl like an elephant's trunk, distance from end of fixed digit to end of spermadactyl 225 μm . Medial surface of femur I with two conspicuous seta-bearing humps.

Deutonymph. Idiosoma 680 μm long, dorsal setae uniform in length, slightly pilose. PDS 100 μm , deeply concave with posterior end of anterior dorsal shield reaching to j2. Distance j6-j6 105 μm , less than distance to posterior tip of anterior dorsal shield. Sternal shield 300 μm . Inguinal gland with 26 pits. Setae behind anus short and pilose. Chelicerae as in female.

Type locality. The type specimen was collected from humus from a deciduous forest east of Tibbs Run Reservoir, Morgantown, West Virginia on 16 January 1981.

Distribution. *V. nodosoides* is known only from the type locality.

Remarks. Setation, sclerotization of the male venter and the presence of seta-bearing humps on femur I of the male indicate a close relationship to *V. nodosa*. The following features help differentiate *V. nodosoides* from *V. nodosa* : 1) lateral lobes of female tectum serrate, not smooth ; 2) fixed digit of chelicera of female without blade-like projection ; 3) preanal setae slightly thickened ; 4) male tectum trilobed, not convex ; 5) inguinal gland with at least 22 solenostomes.

The only known nymph of *V. nodosoides* was collected in June whereas adults were found in January, February, and March.

COMPARISON OF UNISEXUAL
AND BISEXUAL *VEIGAIA*

Of the twenty-five species of *Veigaia* occurring in North America sixteen are bisexual, eight are unisexual (males not present) and one species, *V.*

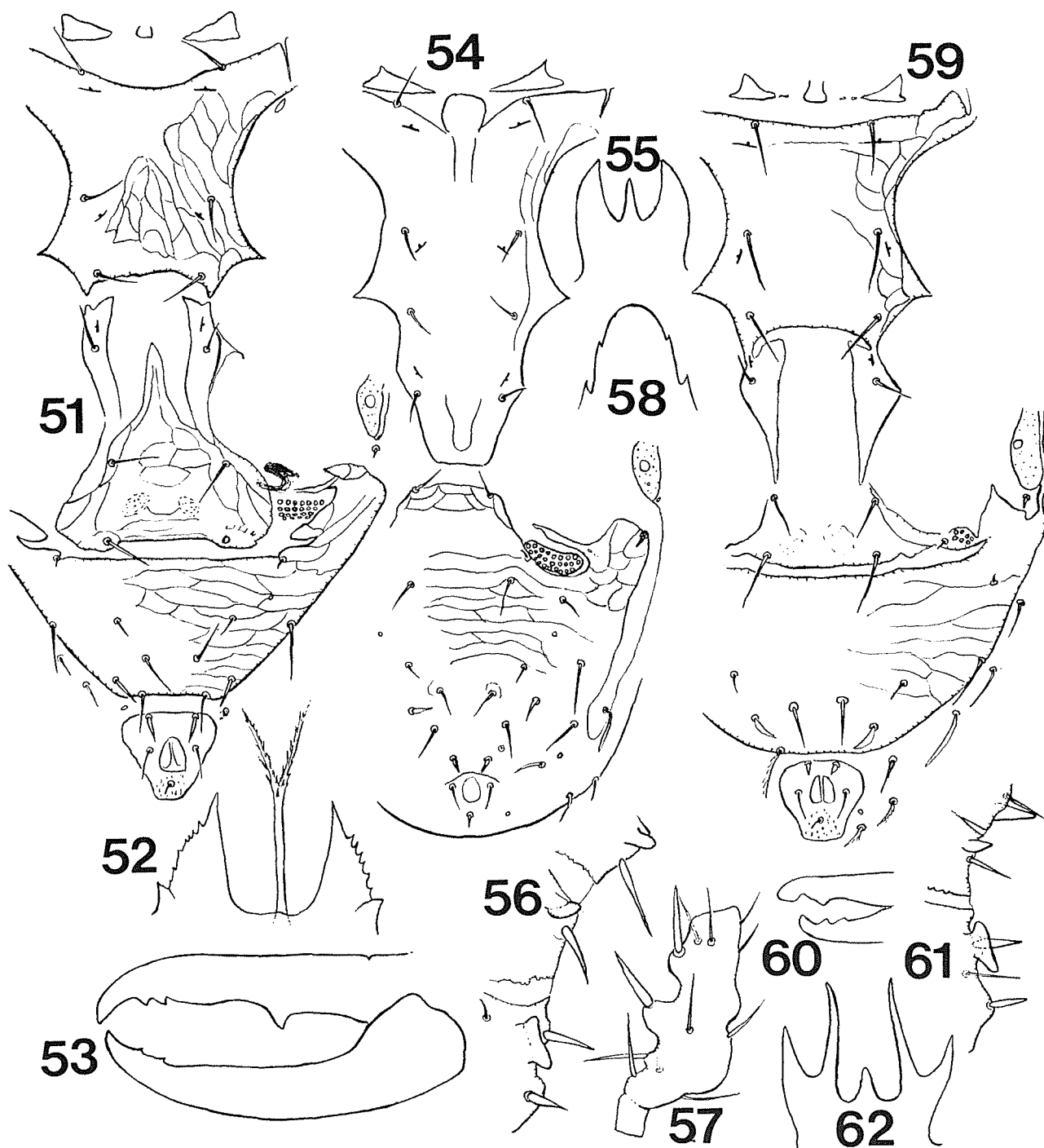


FIG. 51-62 : *Veigaia* spp.

51. — *V. nodosoides* n. sp., ♀, venter. 52. — *Idem*, *Ibid.*, tectum. 53. — *Idem*, *Ibid.*, chelicera. 54. — *Idem*, ♂, venter. 55. — *Idem*, ♂, tectum. 56. — *Idem*, ♂, femur, genu and tibia II. 57. — *Idem*, ♂, femur I. 58. — *V. nodosa*, ♂, tectum. 59. — *V. ignaseta*, ♀, venter. 60. — *Idem*, *Ibid.*, tip of chelicera. 61. — *Idem*, ♂, femur, genu and tibia II. 62. — *Idem*, ♂, tectum.

mitis, includes both unisexual and bisexual populations. The unisexual *Veigaia* have wider geographic distributions (HURLBUTT, 1979) than the bisexual *Veigaia*. For example, six of the eight unisexual *Veigaia* occur in both North America and Europe whereas none of the sixteen North American bisexual *Veigaia* is known to occur outside North America. As in other parthenogenetic animals (GLESENER and TILMAN, 1978) unisexual *Veigaia* also have more northern distributions than bisexual species. Males of *Veigaia* are unknown from Canada and New England, whereas further south they are nearly as numerous as females. The known geographic range of unisexual *V. mitis* is both wider and more northern than that of bisexual populations, although many areas of North America have not been investigated regarding their soil mite fauna.

Are unisexual and bisexual *Veigaia* associated with particular habitats? Parthenogenetic animals tend to be associated with disturbed habitats or habitats in early stages of succession (CUELLAR, 1977). To test the hypothesis that unisexual *Veigaia* are associated with disturbed habitats leaf litter and soil samples were collected concurrently at three localities in northern West Virginia from both within mature deciduous forests and from adjacent brushy areas on the borders between the forests and the fields. The brushy areas were considered to be habitats in relatively early stages of succession based on the kind and age of plants present. Sampling at each of the three localities was repeated on seven different dates.

The research is still incomplete, but at all three localities there was a strong and significant association between bisexual *Veigaia* and the mature forest and between unisexual *Veigaia* and brushy areas, although bisexual *Veigaia* are also sometimes plentiful in old fields and brushy areas. The association was remarkably consistent in that at all three localities and on every date sampling was done, the proportion of unisexual *Veigaia* in samples from the border areas was greater than in the samples from the forest taken on the corresponding date. The locality with the oldest forest (Tibbs Run) had the fewest unisexual *Veigaia*. At Tibbs Run samples collected within

the forest yielded 265 bisexual and 17 unisexual *Veigaia* whereas 146 bisexual and 174 unisexual *Veigaia* were collected from areas bordering the forest. At this locality the bisexual *V. sylvatica* occurred only in the forest while the related *V. mitis*, which is unisexual in West Virginia, occurred only in the brushy areas.

Two unisexual *Veigaia*, *V. partitus* and *V. mitis*, are common in forests, but the microhabitat of *V. partitus* is in many respects in an early stage of succession. This large, swift, usually gravid, long-legged predator occurs almost entirely in the upper layers of the forest floor where the leaves are in an earlier stage of succession than in the deeper and more decomposed layers. In a study of leaf decomposition in North Carolina METZ and FARRIER (1969) found that *V. partitus* invaded leaves earlier than other *Veigaia*.

One of the several advantages of parthenogenesis is that it allows a single individual to form a new colony. To evaluate colonizing ability of *Veigaia* patches of leaf litter and underlying soil from a small plot in West Virginia University Forest (Chestnut Ridge) were deliberately disturbed by baking them in Tullgren funnels until all the mites and other arthropods had disappeared. The dried samples were then returned to their original sites in the forest. Several weeks later numbers of unisexual and bisexual *Veigaia* in the disturbed samples were compared to those of adjacent undisturbed samples to determine if unisexual *Veigaia* recolonized the disturbed samples more than bisexual *Veigaia* did. Twenty-two pairs of samples were analyzed. Ten species of *Veigaia* occurred in the plot, but three bisexual species, *V. dendritica*, *V. gigantea* and *V. philippiensis*, and two unisexual forms, *V. partitus* and *V. mitis*, comprised most of the veigaiid population.

Analysis of the data is incomplete, but the overall results are clear cut. The undisturbed control samples contained a total of 422 bisexual and 253 unisexual *Veigaia*, whereas the disturbed samples had 114 bisexual and 183 unisexual *Veigaia*. Thus the total number of *Veigaia* was less in the disturbed samples than in the controls, but the proportion of unisexual forms was markedly greater in the disturbed samples.

The success of *V. partitus* in the disturbed samples was expected and may be partly due to its high mobility. A comparison of *V. mitis* and *V. philippiensis* is significant because these two mites are very similar in size and structure, but the former is unisexual, whereas *philippiensis* is bisexual. These two species were about equally frequent in the controls. However, virtually no *V. philippiensis* recolonized the disturbed samples, whereas *V. mitis* was actually more plentiful in the disturbed samples than in the controls. (The controls contained 675 *Veigaia* of which 70 were *V. mitis* and the disturbed samples contained 297 *Veigaia* of which 80 were *V. mitis*). The most common veigaiid in the control samples, *V. dendritica*, was a slightly better colonizer than *V. philippiensis*, but was less frequent in disturbed samples than *V. partitus* or *V. mitis*. The results support the hypothesis that unisexual *Veigaia* colonize disturbed habitats better than bisexual *Veigaia* do.

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